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A COMPARISON OF
GASP (GENERALIZED ACADEMIC SIMULATION PROGRAM)
AND
SSSS (STANFORD SCHOOL SCHEDULING SYSTEM)
AS APPLIED TO AN EDMONTON JUNIOR HIGH SCHOOL

BY



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A THESIS

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The increasing complexity of school scheduling has emphasized the need for an aid to the construction of master timetables.

This study dealt with a comparison of the results produced by two computer programs, Stanford School Scheduling System and the

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "A Comparison of GASP (Generalized Academic Simulation Program) and

Specifically, the study answers the following questions:

SSSS (Stanford School Scheduling System) as applied to an Edmonton

1. How many sections of courses are scheduled relative to the Junior High School" submitted by John Yusep in partial fulfilment of

number requested.

the requirements for the degree of Master of Education.

2. How many student requests are scheduled relative to the

ABSTRACT

The increasing complexity of school scheduling has emphasized the need for an aid to the construction of master timetables.

This study dealt with a comparison of the results produced by two computer programs, Stanford School Scheduling System and the Generalized Academic Simulation Program, which have been used successfully in the construction of master timetables.

Specifically, the study answers the following questions:

1. How many sections or classes are scheduled relative to the number requested?
2. How many student requests are scheduled relative to the total number requested?
3. What is the number of courses assigned to rooms relative to the total requested assignment?
4. What is the number of courses assigned to teachers relative to the total requested assignment?

The method used in dealing with these questions was to process identical data through the first phase of the scheduling process. The data was limited to one junior high school.

It was found that the Generalized Academic Simulation Program produced the better results in the four areas investigated.

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TABLE OF CONTENTS

CHAPTER I	PAGE
INTRODUCTION	1
Variations in Organizational Patterns	2
Registration and Scheduling Procedures	3
The Need for Computerized Scheduling	4
PURPOSE OF THE STUDY	5
LIMITATION	5
DEFINITION OF TERMS	6
ORGANIZATION OF REPORT	9
CHAPTER II	
RELATED LITERATURE	10
MASTER SCHEDULE OR TIMETABLE	10
Importance of the Master Schedule	10
Scheduling Problem	11
Computerized Schedules	12
STUDENT-ASSIGNMENT OR CLASS LOADING PROGRAMS	13
Early Scheduling Programs	13
Development of Class Loading Programs	14
Utilization of Existing Data	15
SSS Used in Canadian School Systems	16
MASTER SCHEDULE BUILDING PROGRAMS	17
Generalized Academic Simulation Program	17

Master Schedule Building Procedure	18
GASP System	19
GASP Program Utilization	20
The Stanford School Scheduling Program	21
SSSS System	21
SSSS Utilization	22
CHAPTER III	24
DESIGN AND METHODOLOGY OF THE STUDY	24
BASIC DATA	24
School Parameters	24
Course Tally	26
Course Structure	27
Teacher Assignments	30
Room Assignments	30
Student Course Selections	30
PREPARATION OF DATA	34
OUTPUT	35
SUMMARY	43
CHAPTER IV	48
ANALYSIS OF DATA	48
SECTIONS OR CLASSES SCHEDULED	48
STUDENT REQUESTS SCHEDULED	50

	PAGE
ROOM ASSIGNMENTS	50
TEACHER ASSIGNMENTS	52
CHAPTER V	54
SUMMARY OF STUDY	54
CONCLUSIONS	54
RECOMMENDATIONS	55
BIBLIOGRAPHY	57
APPENDIX A	62
APPENDIX B	64

LIST OF TABLES

TABLE		PAGE
I	Course Offerings	28
II	Course Tally	29
III	Teacher Assignment	31
IV	Room Assignment	32
V	Student Course Selections	33
VI	Course Enrollment Tallies	36
VII	Teacher Module Loads	37
VIII	Room Module Loads	38
IX	Comparison of Classes Scheduled	49
X	Comparison of Student Requests Scheduled	50
XI	Comparison of Room Assignments	51
XII	Comparison of Teacher Assignments	53

LIST OF FIGURES

FIGURE	PAGE
1. Generalized Academic Simulation Program	
Stanford School Scheduling System	25
2. Scheduling Detail For Course 11210	40
3. Effectiveness of Schedule Computed by SSP	41
4. Summary of Course-Phases Scheduled	42
5. Instructor Requests and Assignments	44
6. Room Requests and Assignments	45
7. Student Requests and Assignments	46
8. Listing of Resources Assigned	47

CHAPTER I

INTRODUCTION

During the 1969-70 school term, the Department of Education, Province of Alberta, authorized the use of the revised Junior High School Program.¹ Basically, the changes allow for flexibility in handling schools of varying size, the inclusion of organizational innovations, and the expansion of elective offerings. As a result of this change in organizational philosophy, the need for an improved means of scheduling students to classes was quite apparent.

Deutscher² grouped the junior high schools of Alberta into four categories according to instructional levels: Type I - grades 7-9, Type II - grades 7-12, Type III - grades 1-9, and Type IV - grades 1-12. It is recognized that with this variation in organization some flexibility is required in the scheduling procedures.

The Brookhurst Junior High School Experiment³ showed that by means of flexible scheduling students were able to increase the number of electives selected.

¹Province of Alberta, Junior High School Handbook (1969), Department of Education, Edmonton, Alberta.

²Edward Lloyd Deutscher, "An Analysis of Time Allocation and Scheduling Practices in the Junior High Schools of Alberta," Master's Thesis, University of Alberta, Edmonton, Alberta, 1965.

³Gardner Swenson and Donald Keys, Providing for Flexibility in Scheduling and Instruction. Englewood Cliffs: Prentice-Hall, Inc., 1966.

Variations in Organizational Patterns

Trump,⁴ Bush and Allen,⁵ among others, have dealt with organizational patterns. These patterns are reflected in the master timetable of the school. Five essentials are considered in the construction of a master timetable: (1) students, (2) teachers, (3) rooms, (4) time, and (5) courses. Free selection of courses, grouping of students according to ability or other homogeneous groupings, and class size (large groups, laboratory groups, small groups, independent study groups) are some of the factors to be considered in student identification. Factors affecting teaching personnel may be team teaching, class sizes, and the use of support staff. Although in many cases facilities are fixed, some modifications or rearrangements may be necessary to accommodate flexible scheduling. Time patterns are important variables which affect the organizational pattern of the school. The time modules which make up the day, the time patterns for the courses, and the number and spacing of the classes are but three elements that must be considered in flexible scheduling. New curricula, continuous progress, course structure, teaching machines are other innovations which affect the educational environment. Although not all-inclusive, the above variations illustrate the need for the consideration

⁴J. Lloyd Trump, "New Directions to Quality Education in the Junior High School," National Association Secondary Schools Principal's Bulletin, 45:25-30; September, 1961.

⁵Robert N. Bush and Dwight W. Allen, A New Design for High School Education: Assuming a Flexible Schedule. New York: McGraw-Hill Book Company, 1964.

of flexibility in the area of scheduling.

Registration and Scheduling Procedures

In most secondary schools, the registration and scheduling procedures follow a similar pattern. The students are required to complete preregistration forms early in the year for the following year's registration. Course booklets and other registration information sheets are published for student use. The course selections are discussed with counsellors and/or administrators. The selected courses are listed on registration forms and approved for final processing.

Although slightly different techniques are used, the following steps illustrate the procedures generally taken in the scheduling process after organizational policy matters have been finalized.

1. Course Tally - The course requests are totalled by course or subject.
2. Classes or Sections Required - Class parameters are set and these averages are divided into the total requests. The resulting figures represent the number of classes or sections required.
3. Conflict Sheet or Matrix - This sheet provides in chart form a count of students selecting each course pair. In other words, the subject pairs selected will conflict if they are placed in the same period or block in the master schedule.
4. Master Timetable - The master timetable is constructed by assigning the resources, teachers, rooms, and periods to the various courses offered.

5. Timetable Adjustments - Changes in registration, and late registrations are two factors which may necessitate modifications in the master timetable.

6. Class or Section Assignment - Students are assigned to classes or sections.

7. Conflicts and Late Registrations - Final changes may be made to student timetables, teacher timetables and assignments because of conflicts, late registrations and staff changes.

The Need for Computerized Scheduling

The clerical work involved for administration and staff in the preparation of registration forms, student timetables, class lists, etc. is a time-consuming task. The main function of a school is, of course, education. But, the scheduling of students to selected courses and the keeping of accurate records is basic to the educational program. Electronic data processing is an effective aid to the student accounting field.

School scheduling may be classified into two categories (1) student assignment or class loading programs, and (2) master scheduling programs. Electronic equipment and related programs have been used successfully in the "scheduling" of students.

The need for a local study of master scheduling programs has been emphasized by a number of recent developments. Two of these developments are listed: (1) the introduction of the new junior high school program which has an expanded number of options with varying time patterns, and

(2) an increased interest in the implementation of new instructional methods which include varying group sizes. Both of these developments require some form of flexible scheduling.

The issue that faces the administrator is the selection of a computer program that will effectively and efficiently construct the master timetable.

PURPOSE OF THE STUDY

The purpose of this study is to compare the results generated by GASP (Generalized Academic Simulation Program) and SSSS (Stanford School Scheduling System). Both of these programs have been used in schedule building at the secondary school level.

Specifically the following questions will be answered:

1. How many sections or classes are scheduled relative to the number requested?
2. How many student requests are scheduled relative to the total number requested?
3. What is the number of courses assigned to rooms relative to the total requested assignment?
4. What is the number of courses assigned to teachers relative to the total requested assignment?

LIMITATION

This comparison is limited to the initial scheduling run. No

attempt is made to improve the master schedule. There is no doubt that improvements can be made by adjustments in the resources or the use of supplementary programs that are available with both GASP and SSSS.

DEFINITION OF TERMS

There appears to be a fair degree of confusion regarding the terminology used in the "scheduling" field. The following definitions or explanations are based on those found in Bush and Allen,⁶ Wiley and Bishop,⁷ and the Junior High School Handbook, 1969.⁸

1. Master schedule or timetable is a summary of classes utilizing the available resources which include: instructors, rooms, students and time.

2. The traditional or conventional schedule is one which has a standard period length for all courses or subjects and the courses are repeated in the same manner daily on a weekly basis. An example of a traditional schedule would be a school operating on a five-day cycle with eight periods per day.

3. The flexible or modular schedule is one that has at least the following characteristics: (1) the schedule repeats itself every five

⁶Robert N. Bush and Dwight W. Allen, A New Design for High School Education. New York: McGraw-Hill Book Co., 1964.

⁷W. Deane Wiley and Lloyd K. Bishop, The Flexibly Scheduled High School. New York: Parker Publishing Company Inc., 1968.

⁸Province of Alberta, Junior High School Handbook (1969), Department of Education, Edmonton, Alberta.

days, and (2) periods are not of standard length for all courses.

4. Computerized scheduling programs come in different forms and may be categorized:

(a) Student assignment or class loading programs - these programs or instructions assign students to classes after the master timetable has been constructed by the administrators of the school. Wiley and Bishop describe this loading program in the following manner:

A computer program providing this service demands that the school:

- (1) gather all data pertinent to the building of the master schedule,
- (2) build the master schedule using the best judgment criteria drawn from the data gathered,
- (3) place the school-built master schedule in the computer along with the programs requested by all students.⁹

An example of this type of program is I.B.M.'s Student Scheduling /360.¹⁰

(b) Master Schedule building programs - these instructions actually generate the master schedule as well as loading or assigning the student to classes. Wiley and Bishop differentiate this type of program from the loading program in the following way:

⁹Ibid., p. 5.

¹⁰International Business Machines, Student Scheduling System /360, The Scheduler Program (360A-US-07X), 1967.

These computer programs, providing services vastly different from loading programs, demand that the school:

- (1) gather all data pertinent to the building of the master schedule, and
- (2) prepare this material in some logical arrangement that serves the computer.¹¹

Examples of this type of program are the two programs GASP (Generalized Academic Simulation Program)¹² and SSSS (Stanford School Scheduling System)¹³ which are used in this study.

5. Core subjects or courses are the compulsory subjects which are offered within the following time allotments at the junior high school level:

<u>Subject or Course</u>	<u>Minutes per week</u>
Language Arts	225-350
Mathematics	150-175
Science	150-175
Social Studies	150-200
Physical Education and Health	75-175

Note: At the grade nine level, Group Guidance shall be offered

¹¹W. Deane Wiley and Lloyd K. Bishop, The Flexibly Scheduled High School. New York: Parker Publishing Company Inc., 1968.

¹²William B. Kehl, "360 GASP Generalized Academic Simulation Program 360D," 15.1.004; Cambridge: Massachusetts Institute of Technology, 1967.

¹³Robert V. Oakford, Arthur F. Coombs, Lynne A. Chatterton and Robert Kessler, "Stanford School Scheduling System (SSSS)," Stanford University, School of Education and Department of Industrial Engineering, 1968.

in the core up to seventy-five minutes per week.¹⁴

6. Options or electives are exploratory courses which are taken from the following areas:

(a) Fine and Practical Arts, and

(b) Academic Electives.¹⁵

ORGANIZATION OF REPORT

Chapter II of this report reviews the history and research related to computerized scheduling. The design and methodology of this report will be presented in Chapter III. The results will be reported in Chapter IV. The summary, conclusions and recommendations will form the final chapter.

¹⁴Province of Alberta, Junior High School Handbook (1969), Department of Education, Edmonton, Alberta.

¹⁵Ibid., p. 6.

CHAPTER II

RELATED LITERATURE

The related literature is organized under three main topics: Master Schedule or Timetable, Student Assignment or Class Loading Programs and Master Schedule Building Programs.

MASTER SCHEDULE OR TIMETABLE

Importance of the Master Schedule

The master program is to the high school principal as the musical score is to the concert director, for in either case a soundly planned program, harmonious and tightly knit in all of its component parts, will determine the effectiveness of the individual and his organization.¹⁶

Manlove and Beggs¹⁷ describe the construction and the importance of the master schedule in the following passage.

When the educator constructs the school's master schedule he is arranging precious units -- teaching talents, content, student learning needs, time, and facilities -- in a manner which may or may not be complementary. The way these units are brought together can have a profound effect on both the quality of teaching and learning which goes on in a school. The job of the one who finally constructs the master schedule is to arrange valuable teaching time so that it is potentially possible to use it in the most effective manner. At the same time, the schedule should place students in learning situations that are at once personally rewarding and educationally

¹⁶W. Deane Wiley and Lloyd K. Bishop, The Flexibly Scheduled High School, p. 99. New York: Parker Publishing Company Inc., 1968.

¹⁷Donald C. Manlove and David W. Beggs, Flexible Scheduling, Bold New Venture Series. Bloomington: Indiana University Press, 1965.

productive. This kind of schedule construction demands careful analysis of the teachers' competencies and students' instructional requirements.

Judith Murphy also emphasizes the importance of the master schedule or timetable:

Indeed, the importance of the master schedule can hardly be exaggerated. It abstracts, in words and numbers, the essence of the school. For a given school year, it sets forth in precise detail who is going to do what for every period of every day in the week. Subjects, students, instructors, classrooms are all assigned. From the close study of a master schedule, a canny reader can learn much of a school; the program it offers; the constraint or freedom that affects students' choice of courses; the school's position on the spectrum that runs from ultraconservative to radical; its size, resources, shape -- even its philosophy. In some schools, perhaps most schools, the schedule dominates the students and teachers it is presumably designed to serve. In a minority of schools, happily on the increase nowadays, the schedule reflects fresh efforts to enliven and individualize education.¹⁸

Scheduling Problem

Blakesley¹⁹ defines the scheduling problem by stating that, given sets of course requests, physical facilities, and teaching staff members, an assignment of class meeting times must be found which will meet the following conditions:

1. All of the students, or at least the maximum number, receive an assignment to each of their requested courses.

¹⁸Judith Murphy, School Scheduling by Computer: The Story of GASP, p. 1. New York: Educational Facilities Laboratories, 1964.

¹⁹James F. Blakesley, "Administration -- Integrated Records and Procedures," p. 194, Computers and Education, (editor) Ralph W. Gerard. New York: McGraw-Hill Book Company, 1967.

2. The physical facilities requirement is not in excess of existing facilities, and optimum use is made of these existing facilities.

3. The staff requirement does not exceed the size of the available staff, and optimum use is made of this staff.

Blakesley goes on to say that this problem has been handled (not solved) by trial and error.

Van Dusseldorp and Richardson²⁰ feel that while most schools can profit from the use of some form of computer assistance in their scheduling, each school must be careful to select the service or system most appropriate to its particular needs.

Computerized Schedules

Anderson indicates that at first it was assumed that relief from clerical work was the major reason for going to computerized schedules. Now school administrators are more apt to talk in the following terms:

1. Control. Data availability facilitates better policy decisions, and ready control of data means better execution of these decisions.

2. Experimentation. It is possible to experiment with a school situation without upsetting the present practices and without faculty and students even knowing that experimentation is going on, if necessary. Promising scheduling innovations can be dry run (simulated is the formal word) long before they are put into effect.

3. Individualization. Traditional scheduling patterns more often than not accommodated administrative convenience

²⁰Ralph Van Dusseldorp and Duane E. Richardson, "Secondary School Principal Looks at Computer Scheduling," The High School Journal, Vol. 51, December, 1967, pp. 120-125.

more than anything else. The problem of trying to accommodate individual differences in the many dimensions affecting learning were impossible to solve by manual means.²¹

In selecting the "best" system, the school should bear in mind that the school scheduling may be divided into two levels: (1) the assignment of students to class sections -- student-assignment or class loading, and (2) the building of the master schedule -- master schedule building.

STUDENT-ASSIGNMENT OR CLASS LOADING PROGRAMS

Early Scheduling Programs

The first attempts in computer scheduling were limited to registration and assignment of students to classes. In 1956, Purdue University developed a model from which a scheduling system was introduced at the university level. Using Purdue's model, other universities and I.B.M. began to develop similar programs. These programs were basically student assignment or loading programs.

I.B.M. designed a program known as CLASS (Class Load and Student Scheduling) to be used on an I.B.M. 7070 or 7040 computer. This program was one of the first attempts to meet the unique needs of secondary schools.

²¹G. Ernest Anderson Jr., "New Computer Programs Help Flexible Schedules," p. 67, Nation's Schools, Vol. 81, No. 6, June, 1968.

Development of Class Loading Programs

Dr. Allen J. Gruman²² reports of a comparison of six computer programs for the assignment of students to classes. The computer used, and the programs tested, were as follows:

IBM 7040 -- a program originally developed by G. Ernest Anderson Jr., made available to the Palo Alto School District, Palo Alto, California, and slightly modified by that district for the 7040. Each student is scheduled completely before proceeding to the next one. Classes are filled up to the minimum size, and then a balancing mode is in effect until the maximum sizes are attained. If a conflict occurs for a student, he is not assigned to any class.

CDC 1604 -- a variation of the Anderson program prepared by John Stefani at Control Data's Service Center in Palo Alto. Balancing of enrollments is based only on the maximum class size. A "forcing mode" option is provided, as will be described later in this text.

NCR -- an algorithm similar to the Anderson program developed by NCR at Dayton, Ohio.

IBM 7094 -- a program written for Service Bureau Corporation (SBC) by L.E. Marsters. Maximum class sizes are modified during the initial run to 45 percent of actual. Successive passes of unsuccessfully scheduled students follow, with the maximum sizes reset at 60 percent, 75 percent, 90 percent, 92½ percent, 95 percent, 97½ percent, and 100 percent, respectively. A student must be scheduled completely or not at all on each of the passes.

IBM 1440 -- the SOCRATES program developed by Charles Wilkes. Singleton classes are assigned to all students on the first pass, then doubletons, tripletons, and so

²²Allen J. Gruman, "A Comparison of Computer Programs for the Assignment of Students to Classes: Report of an Experimental Study," p. 8, Journal of Educational Data Processing, Vol. 4, No. 1, Winter 1966-67.

forth, on successive passes. Once a singleton class is assigned to a student, a doubleton request may become a "created" singleton and thus assigned on the same pass. Students are assigned as many classes as possible even though conflicts exist.

H 2200 -- a program developed by Wellesley, Massachusetts, by a group headed by Charles Rose. It uses an algorithm similar to the SOCRATES, but students who develop conflicts are not assigned to any of their course requests.

Dr. Gruman reports that on the basis of evaluative criteria: "(1) number of unscheduled course requests, and (2) class section enrollment, each of the six programs successfully scheduled the students in the test runs."

Schaulis and Carson²³ relate their experiences with the California Educational Information System (CEIS). Their experiences included the following programs: (1) the Anderson-MIT Scheduling Program, (2) SOCRATES, as emulated on the System /360, (3) the System /360 Scheduler, and (4) the California Scheduling System which was developed by the Regional Data Processing Staff and the Honeywell Corporation. At present, a large percentage (approximately ninety-nine percent) of the scheduling done in the California area is in the student assignment or class loading field.

Utilization of Existing Data

Much of the work in the student-assignment type program can be eliminated by utilizing re-usable data from former functioning master

²³Robert E. Schaulis and Marilyn Carson, "School Scheduling," Data Processing for Education, August, 1969, pp. 3-5.

schedules. Levanto²⁴ reports:

Before the computer era at NFA (Norwich Free Academy), the previous year's master schedule was completely scrapped because it was easier to begin anew than to try to salvage parts of the old and risk the entanglements that clerical checking, re-checking and crosschecking would foster. The thinking process of the schedule builder however, is not scrapped on a yearly basis, but rather it passes through various stages of modification to achieve the desired goal. Why not apply the same philosophy to the good old schedule that served so well during the past year? It is estimated that at least 75 to 80 percent of the previous year's schedule is re-usable.

SSS Used in Canadian School Systems

A number of school districts in Canada have been using I.B.M.'s Student Scheduling System. The Data Processing Department of the Toronto Board of Education²⁵ reports that in 1968 a school was scheduled using the SSS program and plans were under way to increase the number of participant schools. The Information Systems Branch, Edmonton Public School Board,²⁶ after a pilot study, introduced the SSS program to nine senior high schools. Based on the number of students scheduled, both departments report successful applications.

²⁴Joseph Levanto, "Mr. Computer -- Assistant Principal," AEDS Journal, June, 1968, pp. 116-117.

²⁵_____Student Scheduling System (mimeographed brochure), The Data Processing Department, Toronto Board of Education, Toronto, Ontario, October, 1968.

²⁶Data Processing Handbook for Senior High Schools, Information Systems Branch, Edmonton Public School Board, Edmonton, Alberta, November, 1969.

MASTER SCHEDULE BUILDING PROGRAMS

While the improved student assignment programs have been developed, implemented and refined, the more difficult task of automating construction of the master schedule has received more attention in recent years. Pioneers in the master schedule building field have been Robert Holz and his associates at the Massachusetts Institute of Technology, and Bush, Allen and associates at Stanford University, California. The two most common programs in the master schedule construction area are GASP (Generalized Academic Simulation Program) developed by the Holz group and SSSS (Stanford School Scheduling System) originated by the Stanford team.

Generalized Academic Simulation Program

The "360 GASP III" program is a version of the original program written by Robert E. Holz in 1961-62.

This version, designed with the modern institution in mind, is able to cope with modular scheduling, team teaching, ability tracking, individual studies, etc.

In contrast to many data processing algorithms GASP is basically heuristic, seeking a 'satisfactory' solution rather than an 'optimal' one. The approach has proven both operationally and economically feasible. Man/machine interaction is required and the system is a successful and powerful 'tool' when used properly as such. Savings in administrative time and effort has been reported as high as 75%. Computer time is difficult to estimate as it is relative to the complexity of the school, but is seldom prohibitively high. A major advantage of automated school scheduling lies in relief from burdens of clerical

detail.²⁷

Master Schedule Building Procedure

Linderman²⁸ points out that the school scheduling problem is a four-dimensional job of assigning: (1) time, (2) instructors, (3) rooms, and (4) students to classes being offered.

The method used in solving this problem is as follows:

An algorithm is a procedure which can be applied to a specific problem in order to achieve an exact or optimal solution; e.g. the steps taken to divide two numbers. An heuristic is like an algorithm except that the procedure or set of steps taken to solve a problem do not guarantee a single optimal solution.

Heuristics involve approximation and estimation. Often, heuristics attack a complex problem by dividing it into parts, the solution of each part ignoring some or all of the interactions with other parts. Where large numbers of permutations or combinations are a part of the problem, randomization and/or probability may be part of the heuristic.

The GASP program uses many heuristics (like those above) and a few algorithms. The results obtained in applying GASP to a particular scheduling problem cannot be guaranteed to the 'best' possible. Experience has shown, however, that the heuristics employed by GASP usually lead to 'good' or 'reasonable schedules'.

Many of the heuristics of GASP are not unlike those of the hand scheduling process, the same trial and

²⁷Robert E. Holz (author), submitted by James L. Linderman, 360 GASP III Generalized Academic Simulation Program 360D, 15.1.004; Massachusetts Institute of Technology, Cambridge, Massachusetts, 1967, pp. Preface.

²⁸Ibid., p. 14.

error methods used by a scheduling officer with traditional aid of pegboards and tags are often reflected in GASP. There are several steps in the process of building a school schedule; at each step there is communication both to and from the assisting computer. The user describes the characteristics of his school as to framework to be completed eventually into a final schedule. This completion of the framework is a feed-back process; that is, GASP is given the framework several times in the process of building a schedule. Ideally these GASP 'runs' are made several days apart and at the end of each run the user may freeze those parts of the schedule with which he is satisfied. He may also find it necessary to change some of the constraints or to alter the request structure in the framework in anticipation of GASP doing a better job on the next run. The process is therefore an iterative one with the user made a part of each loop. In this manner it is possible for the user to inject his knowhow into the scheduling process; it is the human intuition and knowledge of when and what comprises can be made that 'make or break' a schedule.²⁹

GASP System

Jacksteit³⁰ points out that the GASP system consists of nine blocks and indicates the prime function of each block in the following manner:

1. GASP -- accomplishes preparatory or initializing functions,
2. GCOR -- scans and edits time pattern, class, instructor, room, and student records,
3. GUEA -- updates the GASP file on the basis of the correction

²⁹Robert E. Holz (author), submitted by James L. Linderman, 360 GASP III Generalized Academic Simulation Program 360D, 15.1.004; pp. 15-16.

³⁰P. Jacksteit, User's Guide -- Generalized Academic Simulation Programs, International Business Machines, Winnipeg, Systems Engineering Division.

files prepared by the GCOR block,

4. GSEQ -- associates a special sequencing field with each CL (class record) and RE (resource record) record in the GASP file,
5. GATA -- does the primary scheduling in the GASP program i.e. assignments indicates by request fields are satisfied by GATA assignments,
6. GARA -- an auxiliary assignment block which determines the validity of all resource assignments made previously by GATA,
7. GUEB -- an edit program block which checks the file format (instructor, room, student, and time pattern records),
8. GSTO -- this block provides the user with a variety of optional reports,
9. GPRO -- provides the user with a variety of optional 'production documents' suitable for distribution to various personnel.

GASP Program Utilization

Kenney³¹ reported on a research project which involved three schools and showed that GASP "was an extremely powerful and complex tool. Its potential as a tool for upgrading instruction at the secondary school level is virtually unlimited. It is quite flexible and may be adapted to

³¹James B. Kenney, "An Investigation into the Capabilities of the Generalized Academic Simulation Program (GASP) to Construct Three Kinds of Secondary School Timetables." Paper presented in New Orleans, La., in 1968 as part of a seminar sponsored by the Association for Educational Data Systems.

practically any kind of school timetable."

Kenney's evidence supported the proposition that GASP is superior to the manual methods, SHARE, and NEEDS program in terms of (1) flexibility, (2) efficiency of scheduling effort, and (3) cost.

The Stanford School Scheduling Program

The Stanford School Scheduling System³² (known as SSSS) is also a generalized program for constructing a master schedule and assigning students to it. The SSSS seeks to develop the "best" possible schedule through the use of algorithms.

SSSS System

After the collection of the data and the keypunching of this data, the resulting cards are processed through nine extensive computer programs. These programs are: (1) CTTA -- Card to Tape and Audit Program, (2) SSP -- School Scheduling Program, (3) PTWS -- Program to Write Schedule, (4) UDAMC -- Update After Manual Changes, (5) UDCREQ -- Update Course Requests, (6) SAP -- Student Assignment Program, (7) RAP -- Room Assignment Program, (8) UDCL -- Update Class Lists, and (9) TRANSLATE -- translation to readable language.

During each phase there is opportunity for man/machine interaction.

³²Robert V. Oakford, Dwight W. Allen and Lynne A. Chatterton, "School Scheduling -- Practice and Theory," Journal of Educational Data Processing, Vol. 4, No. 1, Winter, 1966-67, pp. 16-50.

SSSS Utilization

Oakford and associates point out that there are at least three related measures of success in evaluating master schedules:

The first measures how well the system has done relative to the formal specifications of the school administrator. The second indicates the satisfaction (or lack thereof) of individuals affected by the schedule. The third compares the resulting schedule with conceivable alternatives.³³

Wiley and Bishop³⁴ relate their experiences with the SSSS program at a particular school and note the effectiveness of computer scheduling as related to curriculum change, school administration, and educational innovations.

Although satisfied with the progress made in the field of flexible scheduling, a note of caution is indicated in the following paragraph:

At no time does SSSS propose to offer a panacea for all of the complex scheduling problems created by many high school instructional programs, so we must indicate that we have not implemented, by any means, a scheduling utopia.³⁵

On the basis of the following five-point rationale: (1) Curriculum expansion and curriculum development, (2) use of flexible time patterns, (3) further professionalization of teachers, (4) the implementation of

³³Robert V. Oakford, Arthur F. Coombs, Lynne A. Chatterton and Robert Kessler, "Stanford School Scheduling System (SSSS)," Stanford University, School of Education and Department of Industrial Engineering, 1968, p. 6.

³⁴W. Deane Wiley and Lloyd K. Bishop, The Flexibly Scheduled High School. New York: Parker Publishing Company Inc., 1968.

³⁵W. Deane Wiley and Lloyd K. Bishop, The Flexibly Scheduled High School. New York: Parker Publishing Company Inc., 1968, p. 163.

new instructional methodology, and (5) the inculcating upon students of some degree of responsibility for their own education, Wiley and Bishop³⁶ feel that the development of variable scheduling and the scheduling program used have been successful and are on "firm ground."

³⁶W. Deane Wiley and Lloyd K. Bishop, The Flexibly Scheduled High School. New York: Parker Publishing Company Inc., 1968, pp. 23-24.

CHAPTER III

DESIGN AND METHODOLOGY OF THE STUDY

Although both GASP³⁷ and SSSS³⁸ accomplish the same objective, the construction of the master timetable, the approach is slightly different. GASP assigns time, instructors, rooms and students to classes whereas SSSS generates the classes based on teacher, room, and student availability. (Figure 1, p. 25) Both programs deal with the resources of the school, namely: time, instructors, rooms, students and courses.

This chapter deals with the gathering of basic data, preparation of data for the computer runs, and the output.

BASIC DATA

School Parameters

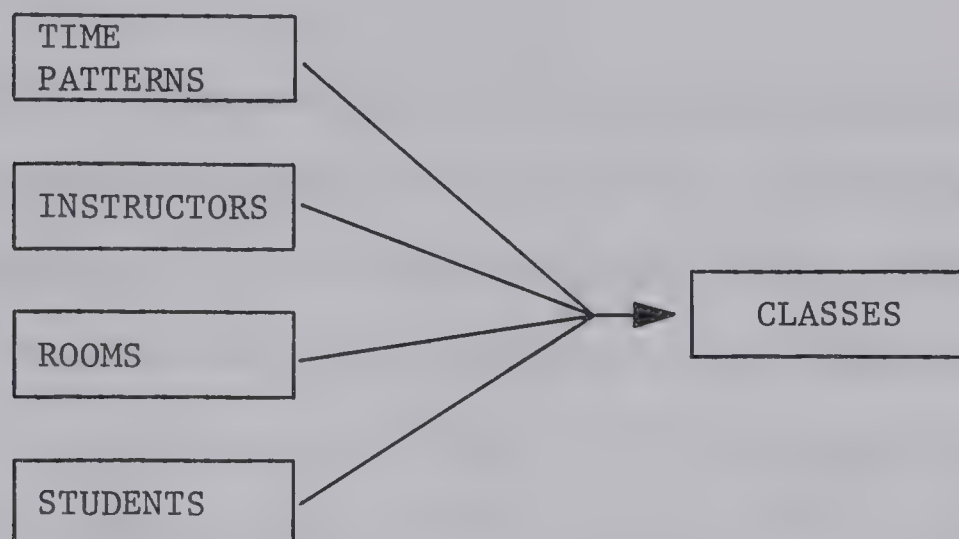
The comparison of the effectiveness of the two scheduling programs GASP and SSSS is based on the data obtained from Killarney Junior High School, Edmonton, for the 1969-70 school term. Killarney is a three-year junior high school, grades 7-9, with 191 students at the grade seven

³⁷Robert E. Holz (author), submitted by James L. Linderman, 360 GASP III Generalized Academic Simulation Program 360D, 15.1.004; Massachusetts Institute of Technology, Cambridge, Massachusetts, 1967.

³⁸Robert V. Oakford, Arthur F. Coombs, Lynne A. Chatterton and Robert Kessler, "Stanford School Scheduling System (SSSS)," Stanford University, School of Education and Department of Industrial Engineering, 1968.

Generalized Academic Simulation Program

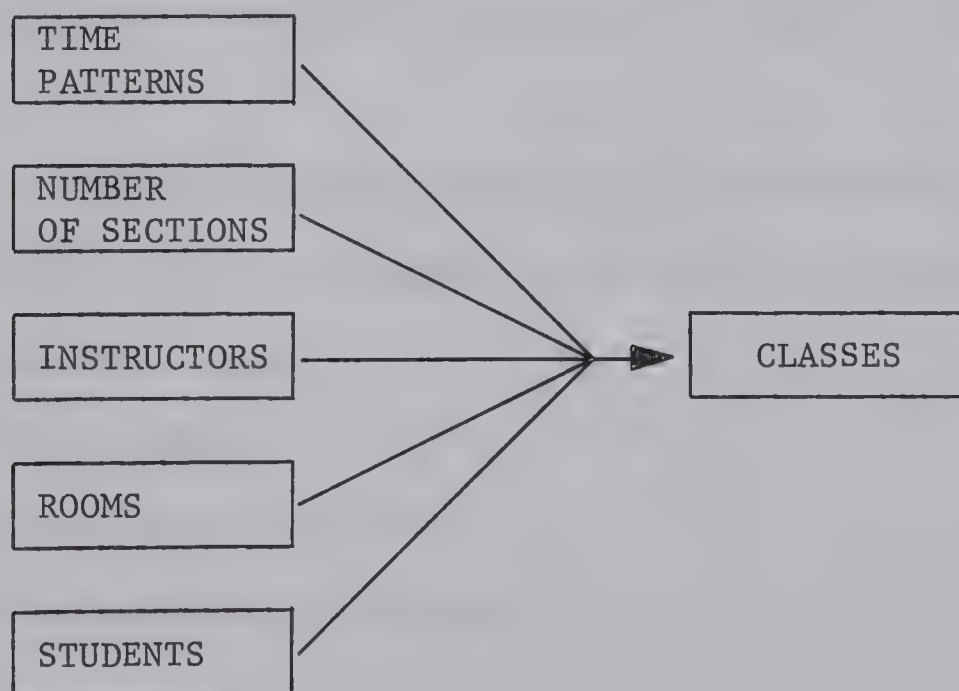
ASSIGNS RESOURCES



With GASP it is possible to get a partial assignment, that is, a class may be scheduled without an instructor or room.

Stanford School Scheduling System

AVAILABILITY OF RESOURCES



SSSS requires that all requested elements of the class are available before an assignment may be made.

Figure 1

level, 141 students at the grade eight level and 196 students at the grade nine level. The total school population in this study is 528 students.

Students at Killarney Junior High School are normally assigned to the core subjects and from two to four options as outlined in the Junior High School Bulletin.³⁹ A detailed listing of courses offered is found in Table I. Those students with less than the maximum number of courses are assigned to study or spare periods. The traditional timetable, that is, a five-day cycle with nine periods per day, with one period (period five) reserved for lunch, was used in this study.

Course Tally

The Course Tally, Table II, lists the number of students requesting each course. These figures, together with the average class size, determine the number of sections (classes) which will be required for each course.

Based on this preliminary course tally, the following courses were cancelled due to low enrollments, availability of teacher or some other administrative reason.

- (1) 010 Reading
- (2) 111 Creative Writing
- (3) 185 Leadership Training

³⁹Department of Education, Junior High School Program 1969, Edmonton, Alberta.

- (4) 191 Communication
- (5) 231 Applied Mathematics
- (6) 262 Industrial Arts - Girls
- (7) 285 Oral Expression
- (8) 288 Leadership Training

The Remedial Reading Courses, numbers 112 and 212, were combined.

Course Structure

The administrative staff at Killarney Junior High School had to make decisions regarding course structure. Course structure refers to the manner in which the resources are organized to study the subject matter. Among others, the following decision had to be made:

- (1) the number of phases for each course,
- (2) the number of periods per meeting,
- (3) the number of meetings per cycle,
- (4) the number of teachers available for each section (class),
- (5) the number of teachers per section (class),
- (6) the number of rooms available for each section (class),
- (7) the number of sections (classes) for each course,
- (8) the section (class) size maximum,
- (9) time pattern specifications.

Most courses had a single phase, that is, the course was composed of one structure. Courses with more than one phase were identified by two additional digits. Each course had a unique three-digit identification. Two digits were added to indicate the phases.

TABLE I

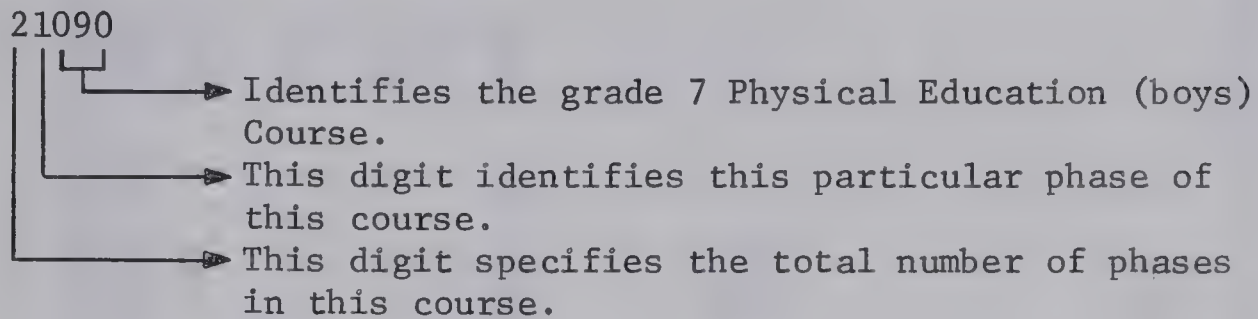
COURSE OFFERINGS

COURSE CODE	GRADE 7		GRADE 8		GRADE 9	
	COURSE NAME	COURSE CODE	COURSE NAME	COURSE CODE	COURSE NAME	COURSE CODE
001	LANGUAGE ARTS	110	LANGUAGE ARTS	210	LANGUAGE ARTS	210
002	SOCIAL STUDIES	111	CREATIVE WRITING	211	CREATIVE WRITING	211
003	HOME ROOM	112	REMEDIAL READING	212	REMEDIAL READING	212
004	MATHEMATICS	120	SOCIAL STUDIES AND HOME ROOM	220	SOCIAL STUDIES MATHEMATICS	220
005	SCIENCE			230		230
010	READING	130	MATHEMATICS	231	APPLIED MATHEMATICS	231
011	REMEDIAL READING	132	REMEDIAL MATHEMATICS	232	BUSINESS MATHEMATICS	232
021	HISTORICAL RESEARCH	140	SCIENCE	233	REMEDIAL MATHEMATICS	233
031	GEOMETRIC DESIGN	141	BIOLOGY	240	SCIENCE	240
032	REMEDIAL MATHEMATICS	142	CHEMISTRY	241	EXPERIMENTAL SCIENCE	241
040	BIOLOGY	150	FRENCH	250	FRENCH	250
041	CHEMISTRY	160	HOME ECONOMICS GIRLS	260	HOME ECONOMICS GIRLS	260
050	FRENCH	161	HOME ECONOMICS BOYS	261	INDUSTRIAL ARTS BOYS	261
052	GERMAN	162	INDUSTRIAL ARTS BOYS	262	INDUSTRIAL ARTS GIRLS	262
054	UKRAINIAN	163	INDUSTRIAL ARTS GIRLS	270	BOOKKEEPING	270
060	HOME ECONOMICS	170	BOOKKEEPING	280	GUIDANCE	280
061	INDUSTRIAL ARTS	180	ART	281	ART	281
080	ART	181	DRAMA	282	DRAMA	282
081	DRAMA	182	INSTRUMENTAL MUSIC	283	INSTRUMENTAL MUSIC	283
082	DRAMA SPECIAL	183	INSTRUMENTAL MUSIC BEGN	284	INSTRUMENTAL MUSIC BEGN	284
083	INSTRUMENTAL MUSIC	184	SOCIOLOGY	285	ORAL EXPRESSION	285
085	ART SPECIAL	185	LEADERSHIP TRAINING	286	PSYCHOLOGY	286
090	PHYSICAL EDUCATION AND HEALTH BOYS	186	ART SPECIAL	287	SOCIAL PROBLEMS	287
		187	DRAMA SPECIAL	288	LEADERSHIP TRAINING	288
092	PHYSICAL EDUCATION AND HEALTH GIRLS	190	PHYSICAL EDUCATION AND HEALTH BOYS	289	ART SPECIAL	289
				290	PHYSICAL EDUCATION AND HEALTH BOYS	290
		192	PHYSICAL EDUCATION AND HEALTH GIRLS	291	DRAMA SPECIAL	291
				292	PHYSICAL EDUCATION AND HEALTH GIRLS	292

TABLE II
COURSE TALLY

COURSE CODE	ENROLLMENT	NO.OF SECTIONS (CLASSES)	COURSE CODE	ENROLLMENT	NO.OF SECTIONS (CLASSES)
001	191	7	180	30	2
002	191	7	181	32	2
003	191	7	182	21	1
004	191	7	183	9	1
005	191	7	184	23	1
010	14	CANCELLED	185	0	CANCELLED
011	6	1	186	26	2
021	21	1	187	29	1
031	22	1	190	65	3
032	22	1	191	11	CANCELLED
040	52	2	192	76	3
041	66	3	210	196	7
050	67	3	211	27	1
052	23	1	212	6	COMBINED 1
054	31	1	220	196	7
060	67	4	230	196	7
061	66	4	231	15	CANCELLED
080	43	2	232	10	1
081	44	2	233	35	2
082	62	3	240	196	7
083	88	3	241	44	2
085	38	2	250	59	3
090	96	4	260	96	6
092	95	4	261	96	6
110	140	6	262	10	CANCELLED
111	6	CANCELLED	270	38	2
112	8	COMBINED	280	196	7
120	141	6	281	52	3
130	141	6	282	65	2
132	18	1	283	19	1
140	141	6	284	13	1
141	33	2	285	9	CANCELLED
142	24	1	286	75	3
150	56	2	287	23	1
160	74	5	288	16	CANCELLED
161	22	2	289	23	1
162	63	5	290	99	4
163	17	1	291	29	1
170	30	1	292	97	4

The following example⁴⁰ illustrates the number of phases in the course and the course identification:



Teacher Assignments

To ensure that teachers are not overloaded and are teaching in their specialty areas, a manual check is made of all teacher assignments. Table III displays the teacher code, the course code and the number of sections (classes) assigned to the teacher.

Room Assignments

As with teacher assignments, a manual check is made to ensure that rooms are not overloaded. Table IV shows the room number, the course code and the number of sections (classes) assigned to that particular room.

Student Course Selections

Students were allowed to select up to a maximum of ten courses. Table V gives a sample of course selections. The first column indicates the student number and the following ten columns indicate the course

⁴⁰Robert V. Oakford, Arthur F. Coombs, Lynne A. Chatterton and Robert Kessler, "Stanford School Scheduling System (SSSS)," Stanford University, School of Education and Department of Industrial Engineering, 1968, p. 11.

TABLE IV
ROOM ASSIGNMENT

ROOM CODE	COURSE CODE	NO.OF SEC	COURSE CODE	NO.OF SEC	COURSE CODE	NO.OF SEC	COURSE CODE	NO.OF SEC	COURSE CODE	NO.OF SEC	COURSE CODE	NO.OF SEC
001	11001	4										
003	11001	2	11003	1	11004	2						
004	11003	1	11005	7								
005	11003	1	11004	3	11011	1	11170	1	11184	1		
006	11003	1	11040	2	11041	3	11001	1				
007	11003	1	11232	1	11031	1	11032	1	11280	7	11004	2
008	11002	7	11003	1								
009	11003	1	11052	1	11270	1	11233	2	22120	1	11021	1
010	11050	3	11054	1	11150	2	11250	3				
012	21120	6	22120	1								
013	11210	4										
014	11110	3	11210	1								
015	11110	3	11112	1	22120	1						
016	22120	1	11211	1	11212	1	11286	3	11287	1	11210	2
017	22120	1	11130	6	11132	1						
019	22120	1	11230	7								
020	11140	6	11141	2	11142	1						
021	11240	7	11241	2								
024	11220	7										
025	11080	2	11085	2	11180	2	11186	2	11281	3	11289	1
026	11083	3	11182	1	11283	1	11284	1				
027	11081	2	11082	3	11181	2	11187	1	11282	2	11291	1
028	11161	2	11260	6								
029	11060	4	11160	6								
030	11163	1	11261	6								
031	11061	4	11162	5								
032	21090	4	21190	3	21290	4						
033	22090	4	22092	4	22190	3	22192	3	22290	4	22292	4
034	21092	4	21192	3	21292	4						

TABLE V
STUDENT COURSE SELECTIONS

STUDENT NUMBER	COURSE 1	COURSE 2	COURSE 3	COURSE 4	COURSE 5	COURSE 6	COURSE 7	COURSE 8	COURSE 9	COURSE 10
00100	110	120	130	140	192	160	180	181	184	000
00150	210	220	230	240	290	241	261	280	283	286
00200	110	120	130	140	192	150	160	180	170	000
00250	001	002	003	004	005	091	085	082	060	083
00350	210	220	230	240	292	241	280	250	260	291
00400	001	002	003	004	005	090	061	083	040	041
00450	110	120	130	140	190	162	150	160	000	000
00500	001	002	003	004	005	091	060	083	041	021
00550	210	220	230	240	292	280	250	260	270	291
00600	210	220	230	240	292	250	260	280	289	286
00650	001	002	003	004	005	090	061	083	054	000
00700	210	220	230	240	292	280	250	260	282	000
00750	210	220	230	240	292	280	250	260	282	000
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.
28100	001	002	003	004	005	092	085	060	050	000
28150	001	002	003	004	005	090	082	083	050	041
28200	210	220	230	240	290	280	281	261	212	233
28250	120	130	140	192	160	163	132	112	000	000
28300	110	120	130	140	192	141	160	186	182	000
28350	110	120	130	140	192	141	150	160	187	000
28400	210	220	230	240	292	280	250	260	291	286
28450	110	120	130	140	192	160	170	180	181	000
28500	210	220	230	240	290	280	281	261	233	000
28550	210	220	230	240	292	211	260	280	289	283
28600	001	002	003	004	005	092	082	083	050	021
28650	210	220	230	240	290	280	282	261	211	241

selected in order of priority. The first listed course has the highest priority.

PREPARATION OF DATA

Two sets of forms (Appendices A and B) were used to obtain the required data for keypunching.

The SSSS forms produced the following data:

- (1) school parameters,
- (2) transfers,
- (3) teacher list data,
- (4) room list data,
- (5) course data packets,
- (6) student request packet.

The GASP forms were used in gathering the following information:

- (1) student information,
- (2) student assignment request,
- (3) time pattern information,
- (4) class information,
- (5) class assignment request,
- (6) instructor information,
- (7) instructor assignment request,
- (8) room information,
- (9) room assignment request.

OUTPUT

Although a great deal of printout was obtained from both GASP and SSSS only a limited amount was used in this study. The remainder of the information would be useful in the final development and improvement of the master schedule.

The programs and output used in each system are outlined below.

1. SSSS - the two components used were INCA (Input Card Audit) and SSP (School Scheduling Program).

(a) The INCA⁴¹ program performs the following functions:

- (i) recording school data as presented on punched cards,
- (ii) checking of data for certain kinds of apparent errors of omission, and for certain kinds of logical inconsistencies,
- (iii) recording of corrections,
- (iv) preparation of data packets to be used by the School Scheduling Program.

The output of the INCA program includes:

- (i) Course Enrollment Tallies - Table VI
- (ii) Teacher Module Loads - Table VII
- (iii) Room Module Loads - Table VIII

⁴¹Robert V. Oakford, Arthur F. Coombs, Lynne A. Chatterton and Robert Kessler, "Stanford School Scheduling System (SSSS)," Stanford University, School of Education and Department of Industrial Engineering, 1968, pp. 3-4.

TABLE VI
COURSE ENROLLMENT TALLIES

COURSE NUMBER	ENROLLMENT	COURSE NUMBER	ENROLLMENT
001	191	163	17
002	191	170	31
003	191	180	30
004	191	181	32
005	191	182	21
011	6	184	23
021	21	186	26
031	22	187	29
040	52	190	66
041	66	192	75
050	67	210	196
052	23	211	26
054	30	212	14
060	67	220	196
061	66	230	196
080	43	232	20
081	44	233	35
082	61	240	196
083	88	241	45
085	38	250	58
090	97	260	94
092	94	261	97
110	140	270	39
112	0*	280	196
120	141	281	53
130	141	282	64
132	18	283	19
140	141	284	21
141	33	286	75
142	24	287	22
150	56	289	23
160	75	290	99
161	21	291	28
162	63	292	97

* students registered in this course have been combined with students in Course No. 212

TABLE VII
TEACHER MODULE LOADS

TEACHER NUMBER	LOAD*	DENSITY**
001	31	78
002	15	38
003	33	83
004	33	83
005	36	90
006	36	90
007	11	28
008	32	80
009	32	80
010	30	75
011	29	73
012	25	63
013	27	68
014	31	78
015	33	83
016	28	70
017	14	35
018	32	80
019	33	83
020	36	90
021	20	50
022	28	70
023	36	90
024	9	23
025	32	80
026	36	90
027	29	73
028	30	75
029	34	85

*Load - number of periods or modules
per scheduling cycle

**Density - percentage

TABLE VIII
ROOM MODULE LOADS

ROOM NUMBER	LOAD*	DENSITY**
001	19	48
003	29	73
004	29	73
005	16	40
006	30	75
007	23	58
008	29	73
009	30	75
010	36	90
012	25	63
013	19	48
014	35	88
015	19	48
016	32	80
017	27	68
019	29	73
020	30	75
021	32	80
024	28	70
025	31	78
026	24	60
027	28	70
028	32	80
029	40	100
030	28	70
031	36	90
032	33	83
033	22	55
034	33	83

*Load - number of periods or modules
per scheduling cycle

**Density - percentage

(b) The SSP⁴² processes the data packets which include time patterns, number of sections, assignable teachers, assignable rooms, and students requesting the course. The output of the SSP program includes:

- (i) page for each course - phase scheduled - Figure 2, p. 40.
- (ii) statistical summary - Figure 3, p. 41.
- (iii) summary of course - phases scheduled - Figure 4, p. 42.

2. The following computer components of the GASP⁴³ system were used in this analysis:

- (a) GASP accomplishes the preparatory or initializing for the following program blocks.
- (b) GCOR scans and edits time patterns, class, instructor, room and student records and expands MACRO records.
- (c) GSEQ associates a special sequencing field with each class and resource record in the GASP file, and determines the order in which GASP will make the assignments.
- (d) GATA does the primary scheduling in the GASP program.
- (e) GARA determines the validity of all resource assignments

⁴²Ibid., p. 4.

⁴³Robert E. Holz (author), submitted by James L. Linderman, 360 GASP III Generalized Academic Simulation Program 360D, 15.1.004; Massachusetts Institute of Technology, Cambridge, Massachusetts, 1967.

Figure 2

SCHEDULING DETAIL FOR COURSE 11210

SSP OUTPUT FOR KILLARNEY JR HIGH													SCHID = 1	VOLSER = 2	DSOATE = 270770	RUNNO = 1	7/29/70	0.10.35
COURSE ...	11210	SECNO ...	160-166	SEQ.CRS.ID. ...	11052	SEQ.NO. ...	1											
TEACHER(S) 19 25 29																		
3 2 2																		
ROOM(S) 11 12 14																		
SECNO - 160	STUDENT(S) -	28	TEACHER(S) -	19														
			ROOM(S) -	11														
TIME-PATTERN ...	M 1 2	W 1 2	TH 1 2	F 1 2														
SECNO - 161	STUDENT(S) -	28	TEACHER(S) -	19														
			ROOM(S) -	11														
TIME-PATTERN ...	M 3 4	W 3 4	TH 3 4	F 3 4														
SECNO - 162	STUDENT(S) -	28	TEACHER(S) -	19														
			ROOM(S) -	11														
TIME-PATTERN ...	M 6 7	W 6 7	TH 6 7	F 6 7														
SECNO - 163	STUDENT(S) -	28	TEACHER(S) -	25														
			ROOM(S) -	12														
TIME-PATTERN ...	M 1 2	W 1 2	TH 1 2	F 1 2														
SECNO - 164	STUDENT(S) -	28	TEACHER(S) -	25														
			ROOM(S) -	12														
TIME-PATTERN ...	M 3 4	W 3 4	TH 3 4	F 3 4														
SECNO - 165	STUDENT(S) -	28	TEACHER(S) -	29														
			ROOM(S) -	14														
TIME-PATTERN ...	M 1 2	W 1 2	TH 1 2	F 1 2														
SECNO - 166	STUDENT(S) -	28	TEACHER(S) -	29														
			ROOM(S) -	14														
TIME-PATTERN ...	M 3 4	W 3 4	TH 3 4	F 3 4														
COURSE 11210																		
SECTIONS - REQUIRED =		7	SCHEDULED =		7	PROPORTION =		1.000										
STUDENTS - IN COURSE =		196	ASSIGNED =		196	PROPORTION =		1.000										
MPG = 4	PPM = 2	SSMAX = 35	SSMIN = 23	ESP = 1	LFP = 9	NON-UNIF = 0	T/S = 1	R/S = 1										
ESS = 0	TV = 0	DI = 0	COMB = 0															
CODE	M - Monday	MPG	- Meetings Per Cycle	ESP	- Earliest Starting Period	R/S	- Rooms Per Section											
T - Tuesday	PPM	- Periods Per Meeting	LFP	- Latest Starting Period	ESS	- Exclusive Student Scheduling												
W - Wednesday	SSMAX	- Section Size Maximum	NON-UNIF	- Non-Uniform	TV	- Teacher Variation												
TH - Thursday	SSMIN	- Section Size Minimum	T/S	- Teachers Per Section	DI	- Day Independence												
F - Friday							COMB	- Combination										

Figure 3

EFFECTIVENESS OF SCHEDULE COMPUTED BY SSP

SSP OUTPUT FOR KILLARNEY JR HIGH SCHID = 1 VOLSER = 2 DSDATE = 270770 RUNNG = 1 7/29/70

NUMBER OF DAYS IN CYCLE = 5 NUMBER OF PERIODS IN DAY = 9 STRAITHRU = 1

FIRST LUNCH PERIOD = 5 LAST LUNCH PERIOD = 5 NUMBER OF PERIODS FOR LUNCH = 1

COURSE-PHASES = 81 SECTIONS = 253 SECTIONS SCHEDULED = 209 FRACTION SCHEDULED = 0.810

COURSES = 74 WITH ESS = 0

COMB MASTER COURSES = 0 WITH ESS = 0

COMB SUB-COURSES = 0 WITH ESS = 0

TEACHERS = 31

PERIODS = 1395 RESERVED = 0 LUNCH = 155 NET = 1240 SCHEDULING DENSITY = 0.674

PERIODS REQUIRED = 836 PERIODS SCHEDULED = 673 FRACTION SCHEDULED = 0.805

STUDENTS = 528

ENROLLMENTS = 5643 ASSIGNMENTS = 4547 FRACTION ASSIGNED 0.806

PERIODS 23760 RESERVED = 0 LUNCH = 2640 NET = 21120 SCHEDULING DENSITY = 0.905

PERIODS REQUIRED = 19120 PERIODS SCHEDULED = 16155 FRACTION SCHEDULED = 0.845

STUDENTS REJECTED = 505 NUMBER OF REJECTIONS = 1096

AVG. NUMBER OF REJECTIONS PER STUDENT REJECTED = 2.170

Figure 4

SUMMARY OF COURSE-PHASES SCHEDULED

SSP OUTPUT FOR KILLARNEY JR HIGH															SCHID = 1			VOLSER = 2			DSDATE = 270770			RUNNO = 1			7/29/70			0.10.35			PAGE 86					
SEQ	HSCID	NS	NSIC	NPIW	REJ	RANK	SEQ	HSCID	NS	NSIC	NPIW	REJ	RANK	SEQ	HSCID	NS	NSIC	NPIW	REJ	RANK	SEQ	HSCID	NS	NSIC	NPIW	REJ	RANK	SEQ	HSCID	NS	NSIC	NPIW	REJ	RANK				
2	11001	191	7	8	0	218	13	21120	141	6	4	0	94	7	11220	196	7	4	0	112	7	11220	196	7	4	0	112	7	11220	196	7	4	0	112				
10	11002	191	7	4	0	109	74	22120	141	6	1	0	23	8	11230	196	7	4	0	112	8	11230	196	7	4	0	112	8	11230	196	7	4	0	112				
67	11003	191	7	1	0	27	14	11130	141	6	4	0	94	42	11232	23	1	2	2	40	42	11232	23	1	2	2	40	42	11232	23	1	2	2	40				
11	11004	191	7	4	0	109	43	11132	18	1	2	10	36	64	11233	35	2002	2	2	35	64	11233	35	2002	2	2	35	64	11233	35	2002	2	2	35	64			
12	11005	191	1007	4	0	109	15	11140	141	6	4	0	94	6	11240	196	7	4	0	112	6	11240	196	7	4	0	112	6	11240	196	7	4	0	112				
45	11011	6	1	2	0	12	65	11141	33	1002	2	22	33	61	11241	45	1002	2	2	37	61	11241	45	1002	2	2	37	61	11241	45	1002	2	2	37	61			
41	11021	21	1	2	12	42	35	11142	24	1	2	18	48	20	11250	58	1003	4	4	42	20	11250	58	1003	4	4	42	20	11250	58	1003	4	4	42	20			
38	11031	22	1	2	4	44	6	11150	56	2	4	0	112	26	11260	94	4006	4	4	62	26	11260	94	4006	4	4	62	26	11260	94	4006	4	4	62	26			
39	11032	27	1	2	6	44	27	11160	75	6006	4	75	50	25	11261	97	5006	4	4	64	25	11261	97	5006	4	4	64	25	11261	97	5006	4	4	64	25			
57	11040	52	2	2	34	52	29	11161	21	2002	4	21	42	31	11270	39	1	2	22	31	11270	39	1	2	22	31	11270	39	1	2	22	31	11270	39	1	2	22	31
62	11041	66	3	2	9	44	28	11162	63	5005	4	63	50	66	11280	196	7	1	0	78	66	11280	196	7	1	0	78	66	11280	196	7	1	0	78	66			
17	11050	67	3	4	5	89	22	11163	17	1	4	0	68	56	11281	53	3	3	22	56	11281	53	3	3	22	56	11281	53	3	3	22	56	11281	53	3	3	22	56
16	11052	23	1	4	15	92	32	11170	31	1	2	26	62	47	11282	64	2	2	9	47	11282	64	2	2	9	47	11282	64	2	2	9	47	11282	64	2	2	9	47
4	11054	30	1	4	0	120	60	11180	30	2	3	10	45	21	11283	19	1	4	14	21	11283	19	1	4	14	21	11283	19	1	4	14	21	11283	19	1	4	14	21
23	11060	67	2004	4	0	67	59	11181	32	2	3	23	48	58	11286	75	3	2	9	58	11286	75	3	2	9	58	11286	75	3	2	9	58	11286	75	3	2	9	58
24	11061	66	2004	4	0	66	18	11182	21	1	4	10	84	40	11287	22	1	2	13	40	11287	22	1	2	13	40	11287	22	1	2	13	40	11287	22	1	2	13	40
55	11080	43	2	3	8	64	19	11284	21	1	4	9	84	37	11289	23	1	2	4	37	11289	23	1	2	4	37	11289	23	1	2	4	37	11289	23	1	2	4	37
53	11081	44	2002	3	44	66	36	11184	23	1	2	12	46	49	21290	99	4	3	6	49	21290	99	4	3	6	49	21290	99	4	3	6	49	21290	99	4	3	6	49
46	11082	61	1003	2	22	40	68	11186	26	1002	2	17	26	71	22290	99	4	1	5	71	22290	99	4	1	5	71	22290	99	4	1	5	71	22290	99	4	1	5	71
5	11083	88	3	4	0	117	30	11187	29	1	2	13	58	33	11291	28	1	2	7	33	11291	28	1	2	7	33	11291	28	1	2	7	33	11291	28	1	2	7	33
63	11085	38	1002	2	34	38	54	21190	66	2003	3	43	66	51	21292	97	2004	3	53	51	21292	97	2004	3	53	51	21292	97	2004	3	53	51	21292	97	2004	3	53	51
50	21090	97	3004	3	90	72	75	22190	66	2003	1	62	22	72	22292	97	4	1	14	72	22292	97	4	1	14	72	22292	97	4	1	14	72	22292	97	4	1	14	72
70	22090	97	4	1	0	24	48	21192	75	3	3	17	75	77	11995	0	4	1	0	77	11995	0	4	1	0	77	11995	0	4	1	0	77	11995	0	4	1	0	77
52	21092	94	2004	3	28	70	69	22192	75	3	1	0	25	78	11996	0	4	1	0	78	11996	0	4	1	0	78	11996	0	4	1	0	78	11996	0	4	1	0	78
73	22092	94	4	1	7	23	1	11210	196	7	8	0	224	79	11997	0	2	1	0	79	11997	0	2	1	0	79	11997	0	2	1	0	79	11997	0	2	1	0	79
3	11110	140	6	8	0	186	34	11211	26	1001	2	26	52	80	11998	0	2	1	0	80	11998	0	2	1	0	80	11998	0	2	1	0	80	11998	0	2	1	0	80
76	11112	0	1	2	0	0	44	11212	14	1	2	7	28	81	11999	0	1	1	0	81	11999	0	1	1	0	81	11999	0	1	1	0	81	11999	0	1	1	0	81

CODE SEQ - Sequence Number
HSCID - Course Code and Phase Designation
NS - Number of Students
NSIC - Number of Sections in Course
NPIW - Number of Periods in Week
REJ - Rejects
RANK - A number computed by the INCA program that indicates relative difficulty of scheduling

made by GATA.

Three reports which were output by GARA were used in this study.

(i) Instructor Requests and Assignments - Figure 5,
p. 44.

(ii) Room Requests and Assignments - Figure 6, p. 45.

(iii) Student Requests and Assignments - Figure 7,
p. 46.

(f) GUEB checks the file format and prints a list of
resources assigned - Figure 8, p. 47.

SUMMARY

This chapter outlined the necessary basic data: school parameters, course tally, course structure, teacher assignments, room assignments and the student course selections; the preparation of the data for keypunching; and the output used in this study.

Figure 5

INSTRUCTOR REQUESTS AND ASSIGNMENTS

GASP LOG FROM GARA BLOCK PAGE 11 07/24/70

INSTRUCTOR	...REQUESTS...					..ASSIGNMENTS..				
	R	T	E	A	M	,	.	\$	*	LD
ICRAWLEY	0	0	0	0	5	5	0	0	0	15
ISALYZYN	0	0	0	0	9	9	0	0	0	36
ISANDE	0	0	0	0	5	5	0	0	0	20
ISEMAKA	0	0	0	0	9	9	0	0	0	36
IWATSON	0	0	0	0	9	9	0	0	0	36
IJONES	1	0	0	0	9	6	0	2	0	26
ICISHI	1	0	0	0	6	7	0	0	0	28
IZIEGLER	1	0	0	0	4	4	0	0	0	26
IHAMPEL	3	0	0	0	9	11	0	0	0	34
IWEIR	4	0	0	0	5	8	0	0	0	29
IARNOLD	5	0	0	0	7	8	0	1	0	25
IHRECHUK	5	0	0	0	0	5	0	0	0	11
ILEWIS	3	0	0	0	5	5	0	3	0	25
INICHOLSON	3	0	0	0	6	8	0	0	0	29
ISAWKA	3	0	0	0	5	8	0	0	0	28
IJESKE	2	0	0	0	12	13	0	0	0	28
IMEEDS	2	0	0	0	6	8	0	0	0	27
ITUBA	2	0	0	0	6	8	0	0	0	32
IWRIGHT	4	0	0	0	6	8	0	2	0	30
IKELLN	1	0	0	0	7	7	0	0	0	26
IHOGARTH	3	0	0	0	11	10	0	3	0	33
IHALLIDAY	3	0	0	0	4	7	0	0	0	33
INIKIPILO	2	0	0	0	10	3	0	7	0	29
IGREENSLADE	3	0	0	0	14	13	0	4	0	33
IKOCUIPCFYK	1	0	0	0	9	9	0	0	0	27
IPOTTER	3	0	0	0	2	5	0	0	0	14
IREGEHER	1	0	0	0	3	4	0	0	0	32
IROSE	2	0	0	0	3	5	0	0	0	33
ITHIESSEN	3	0	0	0	3	6	0	0	0	9
TOTALS	61	0	0	0	189	0	0	0	0	
	29	0	0	0		213	22	27		

CODE

R - Required Requests	,	- Temporary Valid Assignments
T - Track Substitution	.	- Permanent Valid Assignments
E - Elective Requests	\$	- Temporary Invalid Assignments
A - Alternative Requests	*	- Permanent Invalid Assignments
M - Multiple Requests	LD	- Resource Load

Figure 6

ROOM REQUESTS AND ASSIGNMENTS

GASP LOG FROM GARA BLOCK						PAGE 12	07/24/70			
ROOM	...REQUESTS...					..ASSIGNMENTS..				
	R	T	E	A	M	,	.	\$	*	LD
R001	0	0	0	0	4	4	0	0	0	32
R013	0	0	0	0	4	4	0	0	0	32
R021	0	0	0	0	9	9	0	0	0	32
R024	0	0	0	0	7	7	0	0	0	28
R028	0	0	0	0	8	8	0	0	0	32
R029	0	0	0	0	9	9	0	0	0	36
R031	0	0	0	0	9	9	0	0	0	36
R032	0	0	0	0	11	8	0	0	0	24
R033	0	0	0	0	22	22	0	0	0	22
R034	0	0	0	0	11	8	0	0	0	24
R010	1	0	0	0	8	8	0	0	0	32
R020	1	0	0	0	8	9	0	0	0	30
R026	4	0	0	0	3	7	0	0	0	28
R027	2	0	0	0	9	11	0	0	0	28
R030	1	0	0	0	6	7	0	0	0	28
R005	4	0	0	0	3	7	0	0	0	19
R007	4	0	0	0	9	13	0	0	0	22
R016	4	0	0	0	5	6	0	1	0	13
R025	2	0	0	0	8	10	0	0	0	25
R009	6	0	0	0	1	7	0	0	0	20
R015	2	0	0	0	3	4	0	0	0	19
R017	2	0	0	0	6	8	0	0	0	27
R006	3	0	0	0	2	5	0	0	0	15
R003	1	0	0	0	4	3	0	0	0	13
R004	1	0	0	0	7	8	0	0	0	29
R008	1	0	0	0	7	7	0	0	0	25
R012	1	0	0	0	6	6	0	0	0	21
R014	1	0	0	0	3	4	0	0	0	32
R019	1	0	0	0	7	8	0	0	0	29
TOTALS	42		0		199		0		0	
	29		0		0	226		1		26

CODE

R - Required Requests	,	- Temporary Valid Assignments
T - Track Substitution	.	- Permanent Valid Assignments
E - Elective Requests	\$	- Temporary Invalid Assignments
A - Alternative Requests	*	- Permanent Invalid Assignments
M - Multiple Requests	LD	- Resource Load

Figure 7

STUDENT REQUESTS AND ASSIGNMENTS

GASP LOG FROM GARA BLOCK						PAGE 13		C7/24/70		
STUDENT	...PEQUESTS...					..ASSIGNMENTS..				
	R	T	E	A	M	,	.	\$	*	LD
S19800	11	0	0	0	0	9	0	2	0	37
S28250	10	0	0	0	0	9	0	1	0	29
S00100	11	0	0	0	0	9	0	2	0	37
SC0200	10	0	0	0	0	10	0	0	0	34
SC0700	10	0	0	0	0	9	0	1	0	35
SC1200	11	0	0	0	0	9	0	2	0	36
SC1400	11	0	0	0	0	9	0	2	0	37
SC1650	11	0	0	0	0	9	0	2	0	36
SC2900	11	0	0	0	0	9	0	2	0	36
SC2950	11	0	0	0	0	9	0	2	0	35
SC3200	11	0	0	0	0	9	0	2	0	36
SC3300	11	0	0	0	0	9	0	2	0	37
S03493	11	0	0	0	0	3	0	2	0	28
S03500	11	0	0	0	0	3	0	1	0	33
SC3700	11	0	0	0	0	8	0	1	0	31
SC4100	11	0	0	0	0	7	0	4	0	37
SC4400	11	0	0	0	0	8	0	3	0	37
SC4750	11	0	0	0	0	9	0	2	0	36
SC5250	11	0	0	0	0	9	0	2	0	37
S05850	11	0	0	0	0	9	0	2	0	37
S05888	11	0	0	0	0	3	0	3	0	37
S05917	11	0	0	0	0	9	0	2	0	37
S06005	11	0	0	0	0	3	0	3	0	36
S06028	11	0	0	0	0	9	0	2	0	37
SC6100	11	0	0	0	0	9	0	2	0	37
SC6150	11	0	0	0	0	9	0	2	0	36
S06178	11	0	0	0	0	3	0	3	0	36
SC6350	11	0	0	0	0	9	0	2	0	37
SC6800	11	0	0	0	0	3	0	3	0	37
SC7100	11	0	0	0	0	9	0	2	0	37
SC7800	11	0	0	0	0	9	0	2	0	37
SC7900	11	0	0	0	0	3	0	1	0	32
SC7950	11	0	0	0	0	9	0	2	0	36
SC9100	11	0	0	0	0	3	0	3	0	36
SC9500	11	0	0	0	0	7	0	1	0	29
SC9800	11	0	0	0	0	9	0	2	0	37
S10000	11	0	0	0	0	3	0	1	0	32
S10150	11	0	0	0	0	3	0	3	0	37
S10650	11	0	0	0	0	8	0	1	0	32
S11400	11	0	0	0	0	3	0	3	0	37
S11900	11	0	0	0	0	9	0	2	0	37
S12100	11	0	0	0	0	3	0	1	0	31
S12650	11	0	0	0	0	3	0	1	0	32
S13250	11	0	0	0	0	9	0	2	0	37
S13550	11	0	0	0	0	9	0	0	0	32
S13650	11	0	0	0	0	9	0	2	0	37
S14250	11	0	0	0	0	8	0	2	0	35
S14300	11	0	0	0	0	9	0	1	0	35
S14400	11	0	0	0	0	9	0	2	0	36
S14650	11	0	0	0	0	3	0	1	0	31
S14700	10	0	0	0	0	8	0	2	0	37
S15100	11	0	0	0	0	3	0	3	0	37
S15300	11	0	0	0	0	9	0	2	0	37
S15500	11	0	0	0	0	10	0	1	0	37
S16750	11	0	0	0	0	9	0	2	0	37

CODE

R - Required Requests	,	- Temporary Valid Assignments
T - Track Substitution	.	- Permanent Valid Assignments
E - Elective Requests	\$	- Temporary Invalid Assignments
A - Alternative Requests	*	- Permanent Invalid Assignments
M - Multiple Requests	LD	- Resource Load

Figure 8

LISTING OF RESOURCES ASSIGNED

GASP LOG FROM GUEP BLOCK	PAGE 35	C7/4/77	22.35.29	
S	CLIU /11001 01 **R42 42 L *MRF9.00-- IRFCFPER S08450 S22650	TRILANG-APTS S03050 S10950 S03450	11 \$504450 \$517400 \$	11 \$05500 \$13150 \$05200 \$18750 \$506018 \$21000 \$21950 \$21950
	CLIL /11001 02 **R42 42 L *MRF1.00-- IRFCFPER S17550 S27750	TRILANG-APTS S03400 S22235	11 \$01150 \$03650	11 \$12450 \$25750 \$13500 \$25850 \$15500 \$25000 \$15800 \$26150
S	CLIU /11001 03 **R42 42 L *MRF9.00-- IRFCFPER S13800 S27350	TRILANG-APTS S03500 S14800	11 \$03600 \$21350	11 \$10100 \$22300 \$10400 \$22450 \$10600 \$23500 \$12150 \$27300
SR	CLIL /11001 04 **R42 42 L *MRF9.00-- IPCTTER S09800 S21200 S26250	TRILANG-APTS S01579 S11600 S22900	11 \$03900 \$13100 \$24500	11 \$07600 \$13700 \$25200 \$07750 \$17700 \$25300 \$25684 \$09650 \$21065 \$26200
	CLIU /11001 05 **R42 42 L *MRF1.00-- INICHLSEN S09350 S16100 S22750	TRILANG-APTS S03350 S11700 S16800 S25475	11 \$05150 \$14430 \$17100 \$27500	11 \$15430 \$14050 \$18500 \$07300 \$15727 \$20300 \$08250 \$15950 \$16000 \$22664
	CLIL /11001 06 **R42 42 L *MRF2.00-- INICHLSEN S09854 S11250 S16250 S24447	TRILANG-APTS S00250 S06350 S12300 S13450 S27200	11 \$02550 \$08100 \$12300 \$13450 \$27350	11 \$04250 \$0200 \$12850 \$20500 \$28150 \$04660 \$10041 \$14050 \$22550 \$05100 \$10050 \$14370 \$23050 \$05550 \$10300 \$14370 \$23050
S	CLIU /11001 07 **R42 42 L *MRF1.00-- IHALLICAY S10750 S23150	TRILANG-APTS S01200 S13400 S27350	11 \$14500 \$18000	11 \$05431 \$19500 \$05973 \$820350 \$55086 \$22004 \$07450 \$22150

CHAPTER IV

ANALYSIS OF DATA

In this chapter, the findings relative to the study will be reported. Specifically, the following questions will be examined:

1. The number of sections or classes scheduled relative to the number requested.
2. The number of student requests scheduled relative to the number requested.
3. The number of room requests scheduled relative to the number requested.
4. The number of teacher requests assigned relative to the total request assignment.

SECTIONS OR CLASSES SCHEDULED

The comparison of classes scheduled, Table IX, shows the individual courses and the total number of sections or classes scheduled by each program. The course number is indicated in column one. The second column indicates the number of sections requested. The number of sections scheduled by GASP and SSSS are shown in columns three and four respectively.

The total number of sections requested was 245. The number scheduled by the GASP system was 200. This was an effective scheduling rate of 81.6%. The SSSS program scheduled 196 classes for an 80%

TABLE IX
COMPARISON OF CLASSES SCHEDULED

COURSE NUMBER	NUMBER OF SECTIONS	NUMBER OF SECTIONS SCHEDULED		COURSE NUMBER	NUMBER OF SECTIONS	NUMBER OF SECTIONS SCHEDULED	
		GASP	SSSS			GASP	SSSS
11001	7	6	7	11186	2	2	1
11002	7	5	7	11187	1	1	1
11003	7	7	7	11210	7	5	7
11004	7	6	7	11211	1	1	0
11005	7	7	6	11212	1	1	1
11011	1	1	1	11220	7	7	7
11021	1	1	1	11230	7	7	7
11031	1	1	1	11232	1	1	1
11032	1	1	1	11233	2	1	0
11040	2	1	2	11240	7	6	7
11041	3	2	3	11241	2	1	1
11050	3	3	3	11250	3	2	2
11052	1	1	1	11260	6	6	2
11054	1	1	1	11261	6	6	1
11060	4	4	2	11270	1	1	1
11061	4	4	2	11280	7	7	7
11080	2	2	2	11281	3	1	3
11081	2	2	0	11282	2	2	2
11082	3	3	2	11283	1	1	1
11083	3	3	3	11284	1	1	1
11085	2	1	1	11286	3	3	3
11110	6	6	6	11287	1	0	1
11130	6	5	6	11289	1	1	1
11132	1	1	1	11291	1	1	1
11140	6	6	6	21090	4	0	1
11141	2	0	1	21092	4	0	2
11142	1	1	1	21120	6	0	6
11150	2	2	2	21190	3	0	1
11160	6	5	0	21192	3	3	3
11161	2	2	0	21290	4	0	4
11162	5	5	0	21292	4	0	2
11163	1	1	1	22090	4	4	4
11170	1	1	1	22092	4	4	4
11180	2	2	2	22120	6	6	6
11181	2	2	2	22190	3	3	1
11182	1	1	1	22192	3	3	3
11183	1	1	1	22290	4	4	4
11184	1	1	1	22292	4	4	4
					<u>245</u>	<u>200</u>	<u>196</u>

scheduling rate.

STUDENT REQUESTS SCHEDULED

The listing of student requests is summarized in Table X. The total number of students in the study is 528. The total number of requests is 5,643. GASP assigned a total of 4,854 requests for an effective scheduling rate of 86% whereas SSSS scheduled 4,547 requests for an effective rate of 80.6%.

TABLE X
COMPARISON OF STUDENT REQUESTS SCHEDULED

TOTAL NUMBER OF STUDENTS	TOTAL NUMBER OF REQUESTS	TOTAL NUMBER ASSIGNED	
		GASP	SSSS
528	5,643	4,854	4,547

ROOM ASSIGNMENTS

Table XI summarized the room assignments. Column one indicates the room number. Column two indicates the request for the particular room. Columns three and four list the rooms assigned by GASP and SSSS respectively.

In the SSSS program if two or more rooms are specified the program may assign more than the requested number of sections to a particular room. The program uses the room which is most readily

TABLE XI
COMPARISON OF ROOM ASSIGNMENTS

ROOM NUMBER	ROOM PERIODS REQUESTED	ROOM PERIODS SCHEDULED	
		GASP	SSSS
001	4	4	3
003	5	3	7*
004	8	8	7
005	7	7	8*
006	7	5	8*
007	13	13	11
008	8	7	8
009	7	7	7
010	9	8	8
012	7	6	7
013	4	4	3
014	4	4	4
015	5	4	5
016	9	6	8
017	8	8	7
019	8	8	7
020	9	9	8
021	9	9	8
024	7	7	7
025	12	10	10
026	7	7	6
027	11	11	8
028	8	8	2
029	10	9	2
030	7	7	2
031	9	9	2
032	11	8	6
033	22	22	20
034	11	8	7
	246	226	198

* If two or more rooms are specified the SSSS program may assign more than the requested number of sections

available.

Of the 241 requests GASP scheduled 226 whereas SSSS scheduled 198. This gave GASP an effective scheduling rate of 93.8% and SSSS a rate of 82.2%.

TEACHER ASSIGNMENTS

Table XII shows the effectiveness of teacher assignment by GASP and SSSS. Column one indicates the teacher number. Column two the sections requested. Columns three and four the number of sections scheduled by GASP and SSSS.

The total number of sections requested was 250. GASP scheduled 213 or 85.2%. SSSS scheduled 198 or 79.2%.

TABLE XII
COMPARISON OF TEACHER ASSIGNMENTS

TEACHER NUMBER	TEACHER SECTIONS REQUESTED	TEACHER SECTIONS SCHEDULED	
		GASP	SSSS
001	12	8	10
002	5	5	5
003	17	13	15
004	7	7	5
005	12	11	9
006	14	10	12
007	5	5	5
008	14	13	12
009	10	6	8
010	8	7	7
011	10	9	7
012	8	5	8
013	8	8	8
014	9	8	8
015	12	3	10
016	7	7	2
017	5	5	5
018	4	4	4
019	5	5	5
020	9	9	2
021	5	5	5
022	8	8	8
023	9	9	2
024	6	6	6
025	8	8	8
026	9	9	2
027	9	8	8
028	10	8	8
029	5	4	4
	250	213	198

CHAPTER V

SUMMARY OF STUDY

The problem focused on the comparison of the results produced by two computer programs, SSSS and GASP, which have been used successfully in the construction of master timetables. Specifically, the study answers the following questions for each program.

1. How many sections or classes are scheduled relative to the number requested?
2. How many student requests are scheduled relative to the total number requested?
3. What is the number of courses assigned to rooms relative to the total requested assignment?
4. What is the number of courses assigned to teachers relative to the total requested assignment?

The method used in dealing with these questions was to process identical data using only one attempt at the scheduling process.

It was found that GASP produced better results in the four areas investigated.

CONCLUSIONS

The conclusions stated in this chapter were based on data collected, analyzed and interpreted from one junior high school. These conclusions are subject to the limitation of the initial computer run.

The "traditional" type of course structure was another limiting factor.

The GASP program scheduled 81.6% of the sections or classes requested compared to 80% by the SSSS program.

The GASP program scheduled 86% of the student requests compared to 80.6% by the SSSS program.

The GASP program assigned 93.8% of room request assignments compared to 82.2% assignment by SSSS.

The GASP program assigned 85.2% of the teacher request assignments compared to 79.2% by SSSS.

RECOMMENDATIONS

Further research is needed in the area of computerized scheduling. Among others, the following areas should receive special attention.

1. Data Collection -- Assuming that you have the software, the success of a computer application depends on the organization and accuracy of the input data. The writer experienced difficulty in locating nontechnical documentation of the GASP program. The SSSS program is well documented and readily followed by the school administrator. It is recommended that the GASP program receive additional research and study in the area of user documentation.

2. Organization of Input Data -- Although course offerings are not related to any particular scheduling system, the school philosophy, staff, facilities, students and time patterns influence the courses offered. The courses offered in turn influence the success of the

school schedule. The density factor of teachers, student-course, course structure, and facilities determine the effectiveness of the schedule produced. Specific research should be done in comparing the efficiency of the GASP and SSSS programs when the school day is lengthened, when the course structure is altered.

3. Program Alterations -- Although this study was limited to the initial run, it is recognized that the ordering of teacher assignments, room assignments, course selections and time patterns have a decided effect on the school schedule. Modifications in the programs used and the additional programs available may produce better results.

4. Analysis of Output -- A large amount of output is available from both GASP and SSSS. There is limited documentation of how to use this output. No doubt better use would be made of this output if proper documentation were available.

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A P P E N D I X A

COMPARISON OF STUDENT REQUESTS SCHEDULED
(BY COURSE)

COMPARISON OF STUDENT REQUESTS SCHEDULED
(BY COURSE)

COURSE NUMBER	COURSE ENROLLMENT	ASSIGNMENTS		COURSE NUMBER	COURSE ENROLLMENT	ASSIGNMENTS	
		GASP	SSSS			GASP	SSSS
11001	191	180	191	11170	31	25	5
11002	191	165	191	11180	30	28	20
11003	191	187	191	11181	32	22	9
11004	191	157	191	11182	21	18	11
11005	191	159	191	11184	23	18	11
11011	6	6	6	11186	26	21	9
11021	21	18	9	11187	29	24	16
11031	22	21	18	21190	66	36	23
11032	22	11	16	22190	66	66	4
11040	52	39	18	21192	75	61	58
11041	66	58	57	22192	75	69	75
11050	67	57	62	11210	196	168	196
11052	23	20	8	11211	26	23	0
11054	30	24	30	11212	14	9	7
11060	67	67	67	11220	196	161	196
11061	66	66	66	11230	196	169	196
11080	43	37	35	11232	20	18	18
11081	44	37	0	11233	35	30	0
11082	61	54	39	11240	196	179	196
11083	88	80	88	11241	45	38	8
11085	38	32	4	11250	58	53	16
21090	97	75	7	11260	94	94	94
22090	97	97	97	11261	97	97	97
21092	94	55	66	11270	39	32	17
22092	94	91	87	11280	196	195	196
11110	140	116	140	11281	53	52	31
21120	141	48	141	11282	64	60	55
22120	141	136	141	11283	19	18	5
11130	141	108	141	11284	21	15	12
11132	18	7	8	11286	75	75	66
11140	141	119	141	11287	22	21	9
11141	33	27	11	11289	23	14	19
11142	24	20	6	21290	99	86	93
11150	56	40	56	22290	99	99	94
11160	75	74	0	11291	28	21	21
11161	21	21	0	21292	97	55	44
11162	63	63	0	22292	97	95	83
11163	17	17	17				
					5,643	4,854	4,547

A P P E N D I X B

GASP FORMS

SSSS FORMS

CLASS INFORMATION FORM

[illegible]

School Parameters (Deck 1)

INCA Deck 1 Sort Data (10)

cc	70	71			75	76	77	78	80
	*				0	1	1		

★

1. 5 Digit Courses Code Number
2. Number of Sections
3. Mots / Sect.

★This course phase tally unit is to be used in the manual tally of teacher and room usage.

**Total Number of Teachers/
Section to Cover Sections
Requested on Card 1.**

Total Rooms Requested on Card 1.

COURSE PHASE SPECIAL FEATURES										
CC	40	42-43	45-46	48-49	51-60	62	64	66	68-69	
	NON UNIF (1)	TP SPEC. (2)	ESP (2)	LFP (2)	DPS (10)	ESS (1)	TV (1)	DI (1)	RM CLASS (2)	
					DAY PATTERN SPECIFICATIONS	EXCLU. STU SECT'N.	TEACH. VAR.	DAY IND.	ROOM TYPE CLASSIF'N	

COURSE PHASE ROOM DATA												
CC	3		5-7	12-14	19-21	26-28	33-35	40-42	47-49	54-56	61-63	
	R/S (2)		ROOM ID (3)	ROOM ID (3)	ROOM ID (3)	ROOM ID (3)	ROOM ID (3)	ROOM ID (3)	ROOM ID (3)	ROOM ID (3)	ROOM ID (3)	
			ROOM 1	ROOM 2	ROOM 3	ROOM 4	ROOM 5	ROOM 6	ROOM 7	ROOM 8	ROOM 9	

70	71	75	76	77	78	80
*						

INCA

Course Enrollment Transfers (Deck 2)

Description: List all courses that students have requested which should be reassigned or dropped.

From - School Course I.D. Number (3 digit)			To - School Course I. D. Number (3 digit)			Total Number of Students to be Transferred*		
From -	(1) 615	cc (2-4)	To -	608	cc (7-9)	Number	10	cc (12-15)
	(Physiology)			(Advanced Biology)			(Students)	
(2)	615	(19-21)		0	(24-26)		9999	(29-32)
ABOVE SAMPLES: (1) Reassignment, (2) Course Dropped								
From -	(3)	cc	To -	(3)	cc	Number	(4)	cc
		(2-4)			(7-9)			(12-15)
		(19-21)			(24-26)			(29-32)
		(36-38)			(41-43)			(46-49)
		(53-55)			(58-60)			(63-66)
		cc			cc			cc
		(2-4)			(7-9)			(12-15)
		(19-21)			(24-26)			(29-32)
		(36-38)			(41-43)			(46-49)
		(53-55)			(58-60)			(63-66)
		cc			cc			cc
		(2-4)			(7-9)			(12-15)
		(19-21)			(24-26)			(29-32)
		(36-38)			(41-43)			(46-49)
		(53-55)			(58-60)			(63-66)
		cc			cc			cc
		(2-4)			(7-9)			(12-15)
		(19-21)			(24-26)			(29-32)
		(36-38)			(41-43)			(46-49)
		(53-55)			(58-60)			(63-66)

*Note: If all students are to be transferred write 9999 in this column.

INCA Deck 2 Sort Data (10)

cc	70	71	75	76	77	78	80
*			0	1	2		

2233

INCA Deck 4 Sort Data (10)

Teacher
Code No.

70	71	75	76	77	78	80
*			1	5		

INCA Deck 5 Sort Data (10)

Room Code	Number
101	101
102	102
103	103
104	104
105	105
106	106
107	107
108	108
109	109
110	110
111	111
112	112
113	113
114	114
115	115
116	116
117	117
118	118
119	119
120	120
121	121
122	122
123	123
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191	191
192	192
193	193
194	194
195	195
196	196
197	197
198	198
199	199
200	200

STUDENT COURSE REQUEST FORM (Deck 7)

STUDENT MASTER CARD (sequence 1)

STUDENT NUMBER and NAME (last name first) (24)

[illegible]

School Name _____

Date _____

Counselor _____

Homeroom _____

Class _____

[illegible]

COURSE REQUEST DETAIL CARDS

Sequence Priority Number	CARD 2 Course Requests	CARD 3 1st Alternate	CARD 4 2nd Alternate	Card Columns cc
1				(2-4)
2				(6-8)
3				(10-12)
4				(14-16)
5				(18-20)
6				(22-24)
7				(26-28)
8				(30-32)
9				(34-36)
10				(38-40)
11				(42-44)
12				(46-48)
13				(50-52)
14				(54-56)
15				(58-60)
16				(62-64)
17				(66-68)

Note: 1. Accuracy of coding on this form is most important.

Check all data.

2. Extreme care must be used in transferring course code numbers.

2. Extreme care must be used in transferring course code numbers.
3. All coding should be verified by another person prior to key punching.

cc	70	71	75	76	77	78	80
INCA Deck 7 Sort Data					7		



B29980